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PRELIMINARY TRIALS IN MARCOTTING BLACK PEPPER [1]

SALVADOR G. DOLAR [2]

In marcotting, a maximum of 50 per cent success was obtained when the materials used were young shoots with sufficient primordial roots. Primordial roots which are about to come out or just a few days old are found in the second to the fourth nodes from the tip. Vigorous shoots ideal for marcotting are produced in abundance a few weeks after the start of the rainy season.

Black pepper (*Piper nigrum* Linn. var. trioicum CDC) grows or can be grown in several places in the Philippines. Local production of this condiment is highly desirable in order that the country may save on this big item of import (₱49,000.00 for 1958). Several corporations and individual farmers who are interested in its mass propagation and production will want to know a fast and efficient method of propagating this plant.

Cuttings, when available, are usually recommended for use as propagating materials. David (1954) stated that the general practice in the Philippines is to use cuttings, measuring 45 to 60 cm. long, with no less than seven nodes and made from the ends of productive vines during the rainy months. These are preferred to seedlings as planting materials because they fruit early and breed true to type.

On the other hand, Almirante (1955) found that five-node cuttings are advisable to use. Nambiar (1955) reported that in India the farmers usually propagate this plant from vines that trail 2 to 3 feet above the ground or "runners", from gardens 5 to 15 years old. In Sarawak (Sandford, 1952), cuttings are prepared from immature vines which receive regular pruning during the first two years. In the British West Indies (Cooper, 1955), Ceylon (Richards, 1955), India and Glendale (Kurup, 1956), propagation of this plant by single-node cutting with or without leaf gave encouraging results. Blacklock (1957), however, reported that it has been observed in

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[2] Grateful acknowledgment is due Dr. W. C. Kelly, Dr. V. C. Calma, and Mr. L. O. Bondoc for their helpful criticisms in the preparation of this paper.

Indo-China that pepper grown from seed, though it comes into bearing in 4 to 5 years, is more vigorous and more drought resistant than one grown from cutting.

Several methods of rooting these cuttings had been tried locally. Bolaños (1955) found that cuttings from runners produced more roots, more and longer shoots in both the moist chamber and in the mixture of 50% sand and 50% garden soil, than cuttings from the terminals. Macasaet (1955) found that immersion of stem cuttings from one to three days in alphanaphthaleneacetic acid at concentrations of one mg. and 10 mg. per 100 c.c. of water hastened their rooting and shoot growth.

Mondoñedo (1956) observed that woody cuttings, though their rooting is difficult (40 to 50 per cent success only), bear fruit in a year. Whereas, three- to four-node soft stemmed cuttings planted like camote in compost soil, gave more number of living individuals (90 per cent) and bear in two years. According to Torres (1954), the propagating material is the terminal stem with the growing terminal bud of four to six nodes and with developing aerial roots. Some use crawling shoots or "runners" with roots because they observed that the upright shoot from these do not climb. Others would still contest the claim that the top lateral cutting is the best propagating material because they bear fruit earlier.

Brief differentiations of the kinds of cutting mentioned here may be worthwhile. A long, whippy shoot that develops from the base of mature vines and creeps along the ground is referred to as a "runner". The terminal shoot is one which has a climbing tendency and taken from the ends of productive or unproductive vines. The cutting of this kind is best taken from immature vines under two years old. Recently, somebody has coined a term for another kind of cutting which is the "fruiting-stem cutting". This is cutting made from a vine which is mature and bearing. Actually, its use as a propagating material is accomplished by air-layering or marcotting the very young shoot or "watersprout" the node or nodes of which are having a profusion of aerial roots which arise from the ends of bearing, mature vine usually during the rainy months.

The method employed in the present study is very similar in principle to that used in Glendale (Kurup, 1956); that is, inducing the young shoot or watersprout to produce feeding roots while still attached to the parent vine. This study aims to know the character-

istics of the "watersprout" of black pepper, and how successfully it can be marcotted. The black pepper plants in the experimental garden of the Industrial and Perennial Crops Divisions, Department of Agronomy were used in this study.

MATERIALS AND METHOD

The materials in this study were taken from mature, bearing five year old plants climbing vigorously on supports (fig. 1). Sixty young "watersprouts" of different ages were selected from the ends of fruiting stems and divided equally into 3 groups. Individuals of each group had approximately the same age or characteristics at the time of marcotting.

The shoots under group A had aerial roots of white to very light brown in color, 0.5 to 1.5 cm. long and borne on the third node from the tip. They bore two young leaves. The two internodes above the point of marcotting were dark green to violet and the last internode was greenish violet.

The aerial roots of the samples under group B were light brown to brown, 1 to 3 cm. long and borne either on the third or fourth node from the tip of the shoot. They had two to three leaves at the time of marcotting. The color of the internodes of these shoots was approximately the same as those in group A.

Group C was composed of shoots the aerial roots of which were beginning to come out less than 0.5 cm. in length. The point of marcotting was the second node from the tip of the shoot. Their internodes were violet to greenish violet.

All the individuals of the three groups were marcotted on September 4, 1958. Half-pint tin cans with the top totally removed and one side and bottom cut into two with a tin shear were used as containers of ordinary, humus, garden soil in marcotting. Holes big enough for the stems to pass through were punctured at the bottoms of the tin cans. The insertion of the shoot through the separated, slit side of the can was carefully manipulated so as not to damage the stem and aerial roots. Before filling the containers with soil, they were fixed in a position so that the node with the desired kind of aerial roots were more or less half-way the lengths of the cans. In most cases, stakes were used as supports to which the cans were firmly tied. Then the cans were carefully filled almost to the brim

with well-mixed soil. Watering of the "can-fitted" shoots was done to compact the soil and make it come in contact with the aerial roots, instead of pressing down the soil, to avoid breaking the delicate aerial roots. For one month, these "marcots" were watered when necessary.

On October 3, 1958 or approximately thirty (30) days after the "watersprouts" were wrapped with soil in cans, the living young plants of all the groups were severed from their parent plants with the use of a sharp pruning shear and transferred to earthen pots with six-inch top diameter. Soil to fill up the pots were added without, however, disturbing too much the young roots of the plants. Then, they were placed inside the greenhouse and partially shaded. Watering was done daily.

After four months, because of their vigorous growth, the living plants were transferred to bigger pots, mulched with ipil-ipil (*Leucaena glauca* Linn.) leaves. Watering whenever necessary was done until they were one year old.

Data on number of aerial roots, number and length of stem, and number of leaves were taken (1) before the shoots were marcotted, (2) 40 days after they were severed from the parent plants and (3) one year after they were marcotted. A dry season trial was not conducted because very few young shoots appeared at the time.

RESULTS AND DISCUSSION

Plants used. At the start of this trial, the living plants (table 1) under group A had on the average 27 aerial roots and stem-length of 12.6 cm., those in group B, 23 aerial roots and 15.7 cm. of stem; and in group C, 18 aerial roots and 7.0 cm. of stem. The differences among groups in the number of aerial roots were not significant. However, the shoots under group C were significantly shorter than those of the shoots under groups A and B.

The young plants. Between the second and third week after marcotting, most of the shoots developed sufficient amount of delicate, brittle feeding roots. But it was deemed necessary to leave them undisturbed and attached to the parent vines for another week to allow their roots to mature, thus they would be in better condition to withstand the shock of cutting and transplanting.

TABLE 1.—*Number of aerial roots and length of stem at the time of marcotting*

SHOOT NO.	A		B		C	
	No. of aerial roots	Length of stem (cm.)	No. of aerial roots	Length of stem (cm.)	No. of aerial roots	Length of stem (cm.)
Shoots that survived:						
1	38	12.4	17	13.6	29	7.4
2	22	12.5	8	10.2	22	6.3
3	26	9.3	24	18.3	12	6.9
4	8	9.7	17	15.1	22	8.3
5	43	13.1	37	14.0	11	5.7
6	23	12.7	23	21.9	21	9.0
7	14	10.1	33	11.3	16	5.2
8	45	20.6	12	18.2	12	5.6
9	23	13.4	34	18.5	18	8.9
10	—	—	—	—	26	6.3
11	—	—	—	—	15	7.8
Mean	27	12.6	23	15.7	18	7.0
Shoots that died:						
1	67	14.8	22	14.1	26	5.3
2	19	11.3	27	18.6	15	3.2
3	39	14.6	56	17.4	16	3.4
4	10	7.6	24	14.7	18	5.9
5	82	15.5	20	13.4	44	9.0
6	52	12.9	13	13.5	24	7.5
7	43	8.8	51	15.1	13	6.1
8	14	24.7	28	10.9	13	3.5
9	30	9.1	64	10.4	20	5.7
10	47	15.4	42	18.2	—	—
11	28	7.5	27	13.6	—	—
Mean	39	12.9	34	14.5	21	5.5

At the time of severing the 30-day-old marcotted stems from the parent vines, three plants were dead in each of groups A and B, and six in group C; or an 80 per cent rooting average for the three groups. Ten days after cutting, group A had 6 more casualties; group B, 8 and group C, only 3. Two more plants under group A died on the fourth month after marcotting due to waterlogging and most probably fungus invasion of the roots. This leaves 9 living plants each in groups A and B, and 11 plants in group C.

The 40-day old marcots (table 2) of group A had 11 leaves and 6 branches or "stems" of 23.6 cm. in length. The marcots under group B had an average of 9 leaves and 4 branches which were 22.9 cm. long. Group C marcots had on the average 14 leaves and 6 branches of 23.5 cm. in length. Statistically, the three groups did not differ in the aforementioned characteristics.

TABLE 2.—*Number of leaves, and number and length of stems of surviving shoots, 40 days after severance*

SHOOT NO.	GROUP A			GROUP B			GROUP C		
	No. of leaves	No. of stems	Ave. length of stems	No. of leaves	No. of stems	Ave. length of stems	No. of leaves	No. of stems	Ave. length of stems
1	10	5	32.5	6	2	10.2	21	9	29.0
2	15	6	33.9	16	5	30.2	15	9	32.0
3	9	8	30.5	19	6	45.7	5	2	10.8
4	3	2	6.2	4	2	16.0	3	2	14.8
5	17	7	15.5	7	4	13.4	17	8	24.1
6	13	7	30.7	9	4	30.5	22	8	37.5
7	9	4	18.7	5	3	6.5	6	3	29.5
8	9	5	24.2	1	1	10.5	13	7	10.7
9	10	6	20.2	16	5	43.1	17	9	21.6
10							18	9	25.4
11							12	5	23.2
Mean	11	6	23.6	9	4	22.9	14	6	23.5

Two plants under group A had more leaves and branches than the average; similarly, 3 plants in group B and 7 in group C exceeded their respective averages. It will be noted that the highest increment in the length of stems, 40 days after marcotting, occurred among plants of group C, which was 18 cm. as compared to 10.7 cm. and 8.4 cm. among those of groups A and B, respectively.

The one-year-old plants. Table 3 shows the characteristics of these plants (see fig. 2). The plants under group A had on the average 35 leaves and 16 branching stems of 37.2 cm. long. The eleven living plants of group C gave averages of 46 leaves and 24 branching stems which were 38.8 cm. long. These means did not differ significantly. However, plants under group C had still more leaves and stems than the plants in the two other groups.

The living plants under group A gave six spikes to a plant. The average number of spikes to a plant in group B was 8, and in group C, it was 6.

TABLE 3.—*Number of leaves, and number and length of stems of one-year old plants*

SHOOT NO.	GROUP A			GROUP B			GROUP C		
	No. of leaves	No. of stems	Ave. length of stem	No. of leaves	No. of stems	Ave. length of stem	No. of leaves	No. of stems	Ave. length of stem
1	6	3	33.7	80	19	37.2	82	41	49.7
2	45	21	31.8	15	7	31.5	18	8	32.4
3	25	11	41.9	32	15	27.6	73	41	35.5
4	10	3	18.2	54	20	39.9	16	9	31.1
5	35	13	55.9	72	35	37.8	48	23	42.1
6	48	21	42.1	19	11	53.8	39	18	35.7
7	28	11	40.2	57	23	38.9	46	27	32.8
8	67	34	32.2	72	19	60.1	13	11	28.2
9	51	25	39.1	37	13	28.9	42	22	39.6
10							47	23	36.9
11							79	38	62.5
Mean	35	16	37.3	49	18	39.5	46	24	38.8

Based on 20 shoots for each group marcotted, groups A and B gave 45 per cent living plants each while group C gave 55 per cent. Richards (1955) reported to have succeeded in rooting stem cuttings to 44 per cent and Mondoñedo (1956) observed 40 to 50 per sent success. The results of the present trials are comparable to these.

Some of the plants bore inflorescences (spikes) when they were about four months old. However, almost all of them did not develop into mature peppercorns. Most of the spikes which produced peppercorn at one year of age, came out between the 10th and the 11th month after marcotting. The form, venation, and color of the leaves and stems of the 'marcots' are similar to those of the parent vines, except that the former are spreading, non-climbing, and low in habit of growth. At one year of age, the marcots had no vegetative shoots or 'runners', although some upright vines which had spike-bearing potentiality produced new 'watersprouts' in August, 1959. These 'watersprouts' can be used again as propagating materials if deemed necessary. They also tended to produce very few shoots with profuse aerial roots which will likely climb if provided with support.

SUMMARY AND SUGGESTIONS

The trials show that very young shoots produced at the ends of the fruiting stems a few days after the start of the rainy season

Fig. 1. Five year old black pepper plant

Fig. 2. One-year marcotted black pepper plant

can satisfactorily be used as propagating materials. Marcotting of these shoots, however, should be done at the precise age of their aerial roots: that is, when they are about to or have recently come out and are whitish to very light brown in color. This is the best time when they easily become feeding roots which can penetrate and firmly hold the soil so that a satisfactory number of live marcots may be had.

This method of propagation gave approximately 50 per cent success. The author believes that a higher percentage of success may be attained with more judicious watering, careful handling, and sufficient mulching of the young marcots. Waterlogging must be avoided at all times.

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INHERITANCE STUDIES IN RICE[1]

D. A. Ramirez, Sajoso, and F. A. Bernardo

The anthocyanin pigmentation of the apiculus is controlled by two complementary gene pairs and that of the stigma of rice, by three. The coloration of the leaf sheath is controlled by a different set of alleles. Segregation ratios of 9:7, 27:37. and 81:175 were observed.

The ages at heading of F_2 plants of the five crosses were nearer the early than the late parent.

A more complex inheritance was observed in the "runner" character. Segregation ratios of 15:1 and 13:3 were observed, suggesting digenic heredity.

Anthocyanin pigmentation commonly occurs in almost all plant parts of rice, except in the germ and in the endosperm (Gangulee, 1954). The color tones and patterns vary among the different varieties and such attributes have been used extensively in varietal description and distribution. They range from pink, red, reddish purple, purple to purple black.

Although it is of little economic importance and is even considered objectionable in the bran, the study of the presence of anthocyanin pigmentation in plant parts does occasionally help show some genetic association with such important characters as spikelet sterility, vigor of the plant, and even productivity (Ramiah and Rao, 1953).

Hector (1922) as cited by Ramiah and Rao (1953), observed different F_2 segregations of color irrespective of the position of the color. Segregations such as 3:1, 9:7, 27:37, and 15:1 with purple dominant over green were reported. It appeared that at least five genes were involved in the segregations. Purple apiculus was intimately connected with color in (1) leafsheath (Hector, 1922), (2) leafsheath and stigma (Chao, 1928 cited by Ramiah and Rao, 1953), (3) leafsheath, stigma and internode, glume, lemma and palea, junctura and auricle (Yamaguti, 1927 cited by Ramiah and Rao, 1953, and (4) stigma and internode (Hector, 1922).

[1] Central Experiment Station Contribution No. 2026. Studies on the F_2 segregations of anthocyanin pigmentation and maturity periods were based on thesis presented for graduation by Sajoso with the degree of Bachelor of Science in Agriculture, November, 1959. Prepared in the Division of Plant Breeding, Department of Agronomy under the direction of Dr. D. L. Umali, Miss D. A. Ramirez, and Mr. F. A. Bernardo.

In his study of a cross between Nira Vialome (purple) and Caloro (green), Jones (1930) found that in the F_2, the leafsheath and leaf colors segregated in 27 purple: 9 striped purple: 28 green: 28 green. In the F_3 the purple strains either bred true or segregated according to their genetic constitutions, in 3:1, 9:7, or 27:9:28. The internode, glume, and stigma color segregated in 9 purple: 7 green in the F_2. In the F_3 the green strains bred true or segregated 3:1 and 9:7. In this cross he found also that the color of the four groups of colored organs (1) leaves and leafsheaths; (2) awn and apiculus; (3) internodes, glumes, and stigmas; (4) nodes, ligules, auricles, and pulvini, was inherited separately. The color of each group, however, was inherited as a unit and was due to the same genetic factor.

Noshino (1915), as cited by Jones (1928), found that the time of flowering in the F_1 was intermediate but nearer to that of the early parent. In F_2 the segregation was 3 late: 1 early. Jones (1928) himself observed the ratio of 1 early: 2 intermediate: 1 midseason in the F_2. This suggested a single dominant gene controlling the earliness.

"Runners" has been observed in the variety FB-24 (Tepora and Umali, 1957). The inheritance of this attribute has not been reported yet

MATERIALS AND METHODS

Five crosses produced in the Division of Plant Breeding, Dept. of Agronomy, were used in this study. The crosses and their corresponding number designations are as follows:

Cross No.	*Pedigree*
7	Taichu 160 × FB-24
9	Taichu 117 × FB-24
11	PI 160893 × FB-24
14	Karen-iku 5 × FB-24
23	Tainan-iku 516 × FB 24

All the female parents used were Japonica rices, whereas FB-24 is a cross between Fortuna and Seraup Besar. FB-24 has purple leafsheath, apiculus, and stigma. It has runners and is a late maturing variety. The female plants show no pigmentation of these parts. They are without runners and are early-maturing varieties.

The F_2 seeds were sown separately in tin cans filled with 50-50 mixture of garden soil and saw dust. One seedling to a hill was transplanted ten days later. Each F_2 panicle was represented by one row. The rows were spaced 50 cm. apart with 50 hills, 20 cm. apart. The planting was replicated three times.

Observations on the leafsheath color were done before the flowering stage. Apiculus and stigma color was noted when the panicle had just emerged and spikelets were newly opened. The segregation of the different crosses was tested against the ratios previously found by several workers. At harvest time, the runner attribute was noted. Observations on heading date were likewise done.

RESULTS AND DISCUSSION

F_1: Observations on the F_1 plants revealed that the purple pigmentation was dominant over the colorless. All the F_1 plants had purple leafsheath, apiculus and stigma. The F_1 plants were observed to mature at the same time as the early parents, except the crosses between Taichu 160 and FB-24 (65 days) which matured four days later and Tainan-iku 516 and FB-24 (71 days) which matured five days earlier (table 1).

TABLE 1.—*Average number of days from transplanting to heading of the F_1 plants and parents*

VARIETY	F_1 (FB-24 X)	PARENT
Taichu 160	65	61
Taichu 117	70	70
PI 160893	70	70
Karen-iku 5	70	70
Tainan-iku 516	71	76
FB-24	—	112

F_2: Apiculus color. Apiculus color has been considered basic for color formation by most investigators (Gangulee, 1955). In this case the occurrence of color in plant parts is dependent on the coloration of the apiculus. For example, it has been reported by Nakayama as cited by Takahashi (1957), that plants with colorless apiculus or stigma but with colored leaf blade or leafsheath do not exist. Hector (1916) made a similar observation.

Table 2 shows the F_2 segregation for apiculus color and the chi-square tests. All the crosses fit the 9:7 segregation ratio, suggesting that the apiculus color is controlled by two complementing factor pairs. The same ratio was found by Jones (1930), Hector (1913), and Takahashi (1957).

TABLE 2.—*Number of F_2 plants having purple and green apiculus and the Chi-square tests against the 9 purple to 7 colorless ratio*

CROSS NO.	7		9		11		14		28	
Rep.	P[a]	G[b]	P	G	P	G	P	G	P	G
I	28	16	18	29	22	23	18	24	24	24
II	29	22	27	20	26	22	26	21	26	19
III	26	22	24	22	32	16	24	18	20	27
Total	83	60	69	71	80	61	68	63	70	70
X^2[c]	0.1862		2.759		0.014		1.003		2.206	
P	.10 P < .20		.05 P < .10		.90 P < .95		.30 P < .40		.10 P < .20	

[a] Purple.
[b] Green.
[c] Based on the total of the three replications.

The anthocyanin coloration depends on the complementary effect of genes C and A (Nagao and Takahashi, 1955). The formation of the chromogen is controlled by gene C; then gene A exerts its modifying effect on C, turning the chromogen to anthocyanin. The pigmentation is expressed primarily on the apiculus as a result of the interaction of the above mentioned genes. It has also been suggested that the presence of different shades of purple indicates that there is not only one gene A, but several alleles of the A locus, or several duplicate genes of A.

Stigma color. The F_2 segregation of the five crosses with reference to the color of the stigma fits the ratio of 27 purple to 37 colorless (table 3). This ratio could be explained on similar assumptions as those made for the apiculus color. In addition to the basic genes C and A of the apiculus pigmentation, a third gene Sp was present, and the coloration was extended to the stigma. Hector obtained the same segregation ratio.

TABLE 3.—*Number of F_2 plants having purple and green stigma and the Chi-square test for the 27:37 ratio*

CROSS NO.	7		9		11		14		23	
Rep.	P[a]	G[b]	P	G	P	G	P	G	P	G
I	25	19	13	34	20	25	16	26	20	28
II	24	27	13	34	25	23	20	27	25	20
III	22	26	21	25	20	28	20	22	15	32
Total	71	72	47	93	65	76	56	75	60	80
X^2	3.265		1.902		0.886		0.017		0.023	
Probability	.05 P < .10		.10 P < .20		.30 P < .40		.8 < P .9		.8 < P .9	

[a] Purple.
[b] Green.

The combined classification on the color segregation of the two plant parts further illustrates the action of the factor pairs responsible for color. The five crosses fit the expected ratio of 27 purple apiculus and stigma: 9 purple apiculus and colorless stigma: 28 colorless apiculus and stigma (table 4).

TABLE 4.—*Number of F_2 plants having different color combinations of apiculus and stigma with the X^2 test on the ratio of 27 purple apiculus and purple stigma to 9 purple apiculus and white stigma to 28 green apiculus and white stigma*

CROSS NO.	7			9			11			14			23		
Rep.	PP	PW	GW	PP	PW	GW	PP	PW	GW	PP	PW	GW	PP	PW	GW
I	25	3	16	13	5	29	20	2	23	16	2	24	20	4	24
II	24	5	22	13	14	20	25	1	22	20	6	21	25	1	19
III	22	4	22	21	3	22	20	12	16	20	4	18	15	5	27
Total	71	12	60	47	22	71	65	15	61	56	12	63	60	10	70
X^2	5.263			4.304			1.695			2.811			5.40 *		
Probability	.05 < P .10			.10 < P .20			.40 < P .50			.20 < P .30			.05 < P .10		

PP —Purple apiculus and purple stigma.
PW—Purple apiculus and white stigma.
GW—Green apiculus and white stigma.
* Corrected X^2 value.

Leafsheath color. The crosses segregated to different ratios (table 5). Cross Nos. 7, 14, and 23 segregated to the ratio of 27 purple: 37 green, indicating that the attribute is controlled by three

complementary genes. Similar results were found by Jones (1930) and Nakayama (1932), as cited by Takahashi (1957).

TABLE 5.—*Number of F^2 plants having purple and green leafsheath and the Chi-square test against the 27:37 ratio*

CROSS NO.	7		9		11		14		23	
Rep.	P [a]	G [b]	P	G	P	G	P	G	P	G
I	27	23	15	35	22	27	19	31	19	31
II	25	26	16	34	28	22	22	29	23	27
III	24	27	18	32	29	21	25	24	19	31
Total	76	76	49	101	79	70	66	84	61	89
X^2	3.804		5.575 *		7.168 **		0.202		0.882	
P	.025<P.05		.01<P.025		.001<P.005		.148<P.275		.30<P.40	
X^2			0.0805 [c]		.632 [d]					
P			.7 < P .8		.4 < P .5					

* Significant at 5 per cent probability level.
** Significant at 1 per cent probability level
[a] Purple.
[b] Green.
[c] Tested against the 81:175 ratio.
[d] Tested against the 9:7 ratio.

The explanation of the color ratio is similar to that of stigma coloration; i.e., in addition to the basic genes C and A, the localization gene Lsp was present and was responsible for the extension of the pigmentation to the leafsheath (Ramiah and Rao, 1953).

An entirely different behaviour was observed in Cross Nos. 9 and 11. Cross No. 9 had a segregation of 49 purple to 101 colorless. It obviously does not fit the 27:39 ratio. The data fit the 81:175 ratio, indicating that four complementing factor pairs control the color expression on the leafsheath. This suggests that an additional localization gene is included in the genotype of the Taichu 117.

On the other hand, Cross No. 11 shows a two complementary gene reaction. The data fit the 9:7 ratio. Several other workers obtained the same ratio: Farnell, *et al.* (1917), Yamaguchi (1932), and Nakayama (1932), as cited by Takahashi (1957).

The differences in the F_2 segregation of the five crosses suggest the different genotypes of the female parents. This segregation

should, however, be verified by growing the F_3 plants and the segregation studied further.

Another factor that deserves mention is the environmental effect on the color expression. The intensity of pigmentation in the organs, most especially the leafsheath, is greatly influenced by the environment (Ramiah and Rao, 1953). Except for the stigma, light is always essential for the full development of the pigmentation in rice. If fully exposed to sunlight, plants develop deeper pigmentation. The more vigorous plants generally show less development of pigmentation than the less vigorous ones. Plants grown under unfavorable conditions such as lack of water and overcrowding have deeper pigmentation.

Maturity. All the five crosses had an average heading time between the early parent and the late parent, but nearer the former. Similar results were found by Jones in 1935. The data on maturity (table 6) show that all the crosses flowered in two stages and their average heading time falls on either stage. The first stage is a little later than the early parent and the second stage is at about the mean of the two parents. However, Cross No. 11 flowered mostly at the first stage and only a few at the second stage. Cross No. 14 had more or less uniform segregation for heading until the second stage was reached. There were few plants that flowered earlier than the early parent and later than the late parent.

"Runner" character. Cross Nos. 7 and 14 were observed to segregate for the "runner" attribute. Cross No. 7 had a segregation of 183 "runner" type to 13 "non-runner" type. The data fits the 15:1 ratio (table 7). This suggests that the "runner" inheritance in this cross is controlled by duplicating factor pairs.

On the other hand, Cross No. 14 suggests the action of an epistatic gene. The data fit the 13:3 ratio.

It is suspected that the inheritance of the "runner" involved not only two factor pairs. A more complicated gene interaction is suggested by the different segregations of Cross Nos. 7 and 14 and its absence in the other crosses. Even in Cross Nos. 7 and 14 there was variation in terms of the number of "runners" produced in the F_2 plants (fig. 1). Some plants had as many as 15 "runners" while others had only one.

TABLE 6.—*Frequency distribution of the F_2 plants*

DAYS TO HEADING	CROSS NUMBER					DAYS TO HEADING	CROSS NUMBER				
	7	9	11	14	23		7	9	11	14	23
57	2	2				91	1	1	1		
58			1			92	3		1	3	1
59		1				93	1	2	5	2	3
60						94	3	4	1	3	4
61	1		1			95	2		2	1	2
62	1		1			96	5	1		2	1
63						97		3	1	4	1
64						98		2	1	2	
65	1	1	2		2	99				3	3
66	4	4	5	3	3	100	1		1		2
67	25	11	12	6	8	101	1	1	1		1
68	12	2	1	3	4	102	1	4	2		
69	6	8	1	2	5	103			1	1	
70	6	4	6	7	5	104	2				1
71	6	8	9	1	5	105		1			1
72	8	16	24	6	5	106	1	1	2	1	
73	2	1	6		1	107	1	2	1		
74	2	1	4	3	1	108		1	1	1	1
75	3	2	6	1	2	109	1	1		1	
76	1		1	3	1	110					
77	3		6	4	3	111				1	
78	1	2	1	5	1	112					
79	1	2	1		1	113				1	1
80	1	8	6	7	7	114					
81			2	1	4	115		1			1
82	4	1	3	3	5	116					
83	2	4	2	2	4	117					
84		3	1	8	6	118					1
85		3	2	6	3	119				1	
86	4	3	10	9	11	120					1
87	2	6	2	6	11	121	1	2		2	1
88	12	13	2	9	6	122			1	1	
89	1	5	3	3	2	123		1			
90	10	3	3	3	7	124			1		
						Total	145	142	142	131	139

TABLE 7.—*Number of F_2 plants having runner and non-runner attribute and the chi-square tests*

CROSS NO.	RUNNER TYPE	NON-RUNNER	X^2 VALUE	P
7	183	13	0.0490 [a]	.90 < .80
14	147	27	1.1936 [b]	.30 < .20

[a] Tested against the 15:1 ratio.
[b] Tested against the 13:3 ratio.

Fig. 1. F_2 plants segregating for the "runner" and "non-runner" attribute. (Arrow indicate the origin of the "runner").

SUMMARY AND CONCLUSION

1. The pigmentation of the apiculus and stigma is controlled by closely associated gene pairs. The action of the basic chromogen factor C is complemented by A to express the purple pigmentation of the apiculus. The expected ratio 9 colored to 7 colorless was observed. The action of genes C and A was extended to the stigma with the presence of another localization gene Sp.

2. Leafsheath color segregated to different ratios indicating that it is controlled by different genes. The inheritance shows com-

plex reaction. Cross Nos. 7, 14, and 23 seemed to be controlled by the same three complementary factor pairs. Segregation in Cross No. 11 showed that only two factor pairs controlled the character, whereas that of Cross No. 9 showed that four factor pairs were responsible for the anthocyanin pigmentation of the leafsheath.

3. Most of the F_2 plants of the five crosses studied headed nearer the early than the late parent. The maximum flowering was observed at two stages: a little later than the early parent and at about the mean of the two parents.

4. The inheritance of the "runner" character seemed to be controlled by two factor pairs, duplicating genes were observed in Cross No. 7 and epistatic gene in Cross No. 14. A more complex gene interaction is suspected to be responsible for the expression of the "runner" attribute in rice.

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EFFECTS ON DUCKLINGS OF MASH RATIONS WITH DIFFERENT CALORIE-TO-PROTEIN RATIOS WITH AND WITHOUT SUPPLEMENT [1]

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Ducklings were raised up to five weeks of age on mash rations with metabolizable energy value ranging from 1000 to 1227 calories and containing from 17.2 to 20.2 per cent of protein. The calculated metabolizable energy-to-protein ratios were 49:1 to 73:1. The rations brought about significant differences among the various lots of ducklings as regards growth and mortality. However, none of these rations compared favorably with the standard snail-and-rice ration. When the high-protein rations were supplemented with 0.5 per cent of an antibiotic-mineral-vitamin mixture, they were improved considerably and compared favorably with the snail-and-rice ration.

Although duck raising is a very old industry in the Philippines, the feeding of mash has not become widespread. Numerous studies in the College of Agriculture at Los Baños have indicated that mash-fed young ducks grow as fast as those snail- or shrimp-fed. Fronda (1949) showed that a mash mixture containing 52.5 parts by weight of rice bran, 17.5 parts corn meal, and 30 parts of fish meal is the best mash ration for growing ducklings. In spite of the favorable results obtained with mash feeding, it is still common practice for local duck raisers to use the so-called "native" method of feeding.

The "native" method of feeding utilizes cooked rice and chopped fresh shrimps during the first two or three weeks of brooding. After this period, the young ducks are given increasing amounts of corn grits and fresh snails. Snails are the principal feed of the birds with occasional scattering of palay grains twice a day, in the morning and in the afternoon. Water is withheld from the ducklings during the first 4 days of brooding in order to prevent wetting, chilling, and possibly death.

In the United States, a number of nutrition studies (Scott and Heuser, 1951, 1952; Scott *et al.*, 1957; Heuser and Scott, 1952) with

[1] Experiment Station Contribution No. 2027.

Pekin ducks using simple and high energy rations adequately supplemented with vitamins, show that growth was normal and efficiency of feed utilization was satisfactory. When these rations, however, were further supplemented with methionine and unidentified growth factor supplements like fish meal, fish solubles, dried whey, and distillers solubles, no improvement in growth and efficiency of feed utilization was observed.

The nutrition studies conducted at the College of Agriculture Limnological Laboratory, Mayondon, Los Baños from February 13, 1958 to June 6, 1958, are intended to develop a suitable mash ration for growing ducks which could give at least the same results as those of snails in terms of growth and mortality.

MATERIALS AND METHODS

Stock. Mallard ducklings were purchased from a hatchery in barrio Mayondon, Los Baños, Laguna. In each experiment, the ducklings were housed and reared in separate but adjoining pens. In the brooding section of every pen, a thin layer of rice hull was spread to serve as litter. To provide the ducklings a little source of artificial heat in the brooder, a hanging kerosene lamp was lighted the whole evening for the first 4 weeks of each experiment.

Mash-rations. There were 8 different mash mixtures used in the experiments (table 1). The various mash rations were fed

TABLE 1.—*Composition of experimental duck rations used in all experiments*

INGREDIENTS	RATION, PARTS BY WEIGHT							
	1	2	3	4	5	6	7	8
Ground Yellow Corn	50	30	55	35	31	30	30	30
Molasses	10	17	15	17	17	10	—	—
Fine Rice Bran	5	7	6	15	7	10	13	10
Soybean oil meal (44%)	15	15	7	5	15	20	27	32
Corn Gluten Feed (22%)	4	10	4	11	10	10	10	5
Copra meal	4	7	3	5	7	—	—	—
Fish meal (72%)	8	8	8	8	8	8	8	8
Ipil-ipil leaf meal	4	5	3	5	—	—	—	—
Ground Oyster Shell	0.5	0.5	0.5	0.5	10	10	10	10
Total	100.5	99.5	101.5	101.5	105	98.0	98.0	95.0
Calculated composition:								
Protein, per cent	19.8	20.2	16.8	17.2	18.7	24.5	27.6	30.5
Prosphorus, per cent	0.62	0.65	0.72	0.70	0.62	0.73	0.93	0.97
Calcium, per cent	0.72	0.82	0.74	0.79	4.2	4.5	4.6	4.8

dry. In order to avoid wastage of feed, only sufficient amount of each mixture was placed in wooden self-feeders 3 to 4 times a day.

Water was made available immediately upon placing the ducklings in the pens since the mash feeds contained very little moisture. In order to prevent the ducklings from getting wet all over, the water was placed in shallow containers. For the first 4 weeks, the feed and water were made available to the ducklings at all times during the day and night. After this period, the feeding was done only during daytime.

The chemical composition including contents of certain essential minerals, vitamins, and amino acids of the different mixtures were calculated from values reported by the National Research Council (1954) on Nutrient Requirement of Poultry, and Table Internationale de Composition Chimique Des Aliments of the Association Scientifique Du B. N. A., Marseilles, France (1957). The metabolizable energy values were derived from those reported for chicks by Titus (1956) and Hill (1956).

RESULTS AND DISCUSSION

Experiment 1. This experiment was started on February 13, 1958 and concluded on March 19, 1958. The relationship of metabolizable energy to protein (ME/P) and its effect on mortality for the first 4 mash rations used, is presented in table 2. In experiment 1, the mash mixtures used were so formulated that rations 1 and 2 contained high protein and high metabolizable energy.

TABLE 2.—*Rate of mortality as influenced by calorie : protein relationships*

RATION NUMBER	PROTEIN Per cent	METABOLIZABLE ENERGY Calorie/lb	ME/P *	MORTALITY Per cent
1	19.8	1181	59	30
2	20.2	1000	49	20
3	16.8	1227	73	35
4	17.2	1045	60	15
Native Feed	—	—	—	—

* The ME/P ratio is obtained by dividing the calorie by the protein content of the diet.

Two replications were made for each kind of ration including the native feed which served as control. Ten ducklings for each

replicate was used or a total of 100 ducklings. The average gain in weight at 5 weeks of age is shown in table 3.

TABLE 3.—*Average gain in weight of 5-week old ducklings (grams)*

	RATION NUMBER					HSD	
	1	2	3	4	Native	1%	5%
Total	408	455	354	534	693		
Mean	204.0	227.5	177.0	267.0	346.5	98.604	72.271

Experiment 1 shows that the ducklings given the native feed had a significantly greater average gain in weight than those fed with mash rations. Mortality was at a low rate of 5 per cent (table 2). Among the mash-fed lots, the differences in body weight gains at 5 weeks of age were significant except between rations 1 and 2, and rations 1 and 3. This simply indicated that the varying protein content for rations 1 to 4 of 19.8 to 17.2 per cent which are all higher than the N.R.C. (1954) requirement of 17.0 per cent (for starting and growing ducks), did not consistently have significant favorable effect upon rate of growth even when the energy content of the rations was maintained at a fairly good level. Scott *et al.* (1959) pointed out that no marked differences in growth were obtained by using diets of wide range in protein and energy content. In the present study the ME/P ratios ranged from 49:1 to 73:1.

Experiment 2. Because of the poor growth response and high mortality of the ducklings in experiment 1, it was suspected that the mash rations used were nutritionally deficient. Experiment 2 was, therefore, conducted to improve the growth of the ducklings by increasing the protein content of the rations and by adding a special feed supplement called Afsilin #1. The guaranteed analysis for every 10 pounds of the supplement is as follows:

Vitamin A, U.S.P. Units	3,000,000.0
Vitamin D_3, I.C. Units	1,000,000.0
Riboflavin, mg.	3,000.0
Pantothenic Acid, mg.	4,000.0
Niacin, mg.	20,000.0
Choline, mg.	200,000.0
Procaine Penicillin, gm.	4.0
Vitamin E, I.U.	1,000.0
Vitamin B_{12}, mcg.	9,000.0

Trace Minerals, mg.*	140,000.0
Butylated Hydroxy Toluene, lb.	0.25

* Manganese	1.200	per cent
Iodine	0.024	" "
Iron	0.400	" "
Copper	0.040	" "
Crude Protein	15.000	" "
Crude Fiber	19.000	" "
Ash	17.000	" "

Rations number 5, 6, 7, and 8 which contained 18.7, 24.5, 27.6, and 30.5 per cent protein, respectively, were fed to 3-week old ducklings that were previously fed with boiled shrimps supplemented with small amount of mash rations 1, 2, 3, and 4. Experiment 2 was started on March 24, 1958 and terminated on June 6, 1958. As in the first experiment, there were 2 replications in experiment 2 using 10 female ducklings in each lot or a total of 100 female ducklings.

The results of experiment 2 for mortality rates are shown in table 4.

TABLE 4.—*Mortality of 11-week old female ducklings in experiment 2*

RATION NUMBER	PROTEIN CONTENT Per cent	MORTALITY Per cent
5 plus 0.5 per cent Afsilin	18.7	0
6 plus 0.5 per cent Afsilin	24.5	0
7 plus 0.5 per cent Afsilin	27.6	0
8 plus 0.5 per cent Afsilin	30.5	0
Native feed	—	5

No bird died in the Afsilin-supplemented mash rations. In the native-fed lot, however, a mortality of 5.0 per cent was observed. The antibiotic part of the Afsilin supplement was possibly responsible in preventing mortality among the mash-fed ducks. The vitamin and mineral portions of the supplement which increased body vigor and vitality may also have contributed to the reduced rate of mortality.

The average gain in weight of the female ducklings from the third to the eleventh week is presented in table 5. Although the differences in weight gain between the lots fed with mash rations and those with snails were not statistically significant, the results indicated that the supplementation of Afsilin to the mash rations

consistently accelerated growth. Statistical analysis showed that Ration 7 gave a significantly higher gain in weight as compared to the native-fed lot.

TABLE 5.—*Average gain in weight (grams) of female ducklings*[a] *in experiment 2*[b]

	RATION					TOTAL
	5	6	7	8	Native	
Total	1897	1963	2036	1934	1833	9663
Average	948.5	981.5	1018.0	967.0	916.5	—

[a] Average gain from 3rd to 11th week of age.
[b] Differences were not significant.

The level of protein in the mash rations did not significantly affect the birds' increase in weight. Ration number 8 which contained 30.5 per cent protein or 11.8 per cent more than ration 5 produced ducklings of practically the same average gain in weight. Results showed that the addition of Afsilin (antibiotic-mineral-vitamin supplement) to mash ration number 5 to 8 gave the same effect on rate of growth regardless of the protein level when this is above the N.R.C. protein requirement of 17.0 per cent.

Experiment 3. This experiment was conducted using drakes (male ducklings) raised to 4 weeks of age. Mash rations 5, 6, and 8 were used in 2 replications one of which is supplemented with 0.5 per cent Afsilin. This is to test the difference which the addition of 0.5 Afsilin can have on weight. The results of this study which began on May 9, 1958 and concluded on June 6, 1958 are presented in table 6.

TABLE 6.—*Average gain in weight and mortality of drakes raised to 4 weeks of age in experiment 3.*

RATION NUMBER	NUMBER OF BIRDS	AFSILIN Per cent	AVERAGE GAIN grams	MORTALITY Per cent
5	12	(1) None	225.0	8.3
	10	(2) 0.5	303.8	20.0
6	10	(1) None	299.0	0.0
	10	(2) 0.5	318.5	0.0
8	10	(1) None	269.0	0.0
	12	(2) 0.5	310.5	16.7

The differences of the gains in weight between the supplemented and unsupplemented lots were insignificant although the

supplemented lots gave a consistently higher average gain in weight than the unsupplemented ones.

Ration 5 without Afsilin supplementation gave a low average gain in weight as compared to the other test birds. Of the mash rations used in experiment 3, unsupplemented rations 6 and 8 contained more niacin, vitamin B_{12}, choline, and the combined amounts of methionine and cystine than ration 5 as shown in table 7. The lack of any of these nutritional factors in ration number 5 might have contributed to the slower growth of the drakes. Scott, *et al.* (1957) specifically pointed out that rations adequately supplied with known vitamins especially niacin, improved rate of growth in Peking ducks. In experiment 3, the niacin content of ration 5 is lower than ration 6 and 8 by 8.5 and 7.1 milligrams per kilogram of feed, respectively.

TABLE 7.—*Composition of mash rations number 5, 6, and 8 for certain vitamins and amino acids*

NUTRITIONAL FACTOR	RATION 5	RATION 6	RATION 8
Niacin, mg./kg.	51.3	60.8	58.4
Vitamin B_{12}* mcg./kg.	17.5	32.9	39.4
Choline, mg./kg.	1370	1868	1888
Methionine and cystine, per cent	0.55	0.55	1.0

* Calculated from fish meal alone.

CONCLUSION

In experiment 1, 5-week old ducks fed with mash rations with metabolizable energy-protein rations ranging from 49:1 to 73:1 were significantly lighter in average gain in weight and had a higher mortality than the birds given the native feed.

The addition of Afsilin #1 in experiment 2, a feed supplement containing vitamins, minerals, antibiotics, and antioxidants to practical-type mash rations containing higher protein than the one recommended by the National Research Council, greatly improved growth and reduced mortality at a rate favorably comparable to ducks fed with snails.

The withdrawal of the Afsilin supplement from ration 5 in experiment 3, slowed growth but the differences in average gain in weight as compared to the other mash rations with and without the supplement were insignificant.

From the results of these studies, it can be concluded that mash rations supplemented with a suitable concentrate containing vitamins, minerals, antibiotics, and other nutritional factors, are as good as snails and palay in terms of promoting growth and reducing or preventing mortality of growing ducks.

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SOME EFFECTS OF FERTILIZERS ON YELLOWING COCONUT [1]

B. C. Felizardo and N. L. Galvez

The application of fertilizers to dug areas around the trees corrected the yellowing malady of the coconuts and improved their fruiting capacity. During the second year, the NPK treatment gave the highest yield and was 84 nuts per plot more than the plot without fertilizers. The increase in nut yield ascribable to the individual elements when compounded successively, were 43 nuts per lot for nitrogen, 23 nuts for phosphorus, and 18 nuts for potassium. The relationship is actually more complex than this.

The application of ammonium sulfate tended to increase the sulfur and nitrogen content of the leaves of the coconut trees which were both associated with yield.

The pH of the surface soil was decreased by the application of 1 kilogram of N per tree per year. Application of phosphorus and potassium containing fertilizers replenished the enhanced amount absorbed from the soil, when the yield was greatly increased by nitrogenous fertilizers.

Yellowing of leaves is one of the most important abnormalities of coconut trees in the provinces of Laguna, Quezon, and Batangas. It has become an important problem because it greatly reduces yield.

At the early stage of the malady the young leaves assume a fading green color. Leaves become more yellow as they grow older. The newest leaf is always shorter than its predecessor thus a coconut tree with a greatly reduced crown results. Old leaves die faster than new ones are formed so that at the advanced stage of yellowing, only a few pairs of short leaves make up the crown. No fruit develops at the late stage of the malady. This is probably quite different from what is commonly known as cadang-cadang in the Bicol region because of the non-existence of water-soaked lesions in the infected leaves at any stage of yellowing (Kent, 1953).

With the assumption that yellowing is caused by poor physical condition of the soil, Bruce, Carandang, Marcaida and Peñaflor [2]

[1] Central Experiment Station Contribution No. 2028. The first year result of the experiment was presented in the First Southeast Asia Soil Science Conference held in Manila in 1957.

[2] Undergraduate thesis students in the Department of Soils in 1956 advised by Dr. Marlin G. Cline. Their theses are not published.

worked on the bulk density of both high and low yielding coconut soils in different parts of Laguna and concluded that soil compaction can not be the cause. Escritor (1954) reported that the total nitrogen, available phosphorus, exchangeable calcium and potassium, and organic matter were consistently higher in the high yielding coconut soils than in the low yielding ones in Gumaca, Quezon.

To determine the effects of fertilizers on the growth and yield of yellowing coconuts, a study was conducted by the Department of Soils from April, 1955 to April, 1958. Aside from the soil, the sulfur and nitrogen content of the leaves were analyzed to determine the nutrient status of the trees.

MATERIALS AND METHODS

An old coconut plantation in barrio Duhat, Santa Cruz, Laguna with yellowing trees was studied. The area is generally level and abundantly covered with amorseco (*Andropogon aciculatus* Retz.) and cogon (*Imperata cylindrica* Linn.). As recalled by the overseer, there had been no fertilization, eradication of amorseco, covercropping, green manuring or loosening of the soils in the plantation for the last 30 years. Because of the malady most of the trees had no fruits and were moribund at the beginning of the experiment.

The soil is silt loam with good external drainage. Its chemical properties are shown in table 1.

TABLE 1.—*Chemical analyses of monolithic samples*

SOIL HORIZON	DEPTH IN INCHES	pH	O.M.	TRUOG P IN PPM	C.E.C.	EXCHANGEABLE			
						Ca	Mg	K	Na
						in m.e./100 grams soil			
A_{1p}	0–8	6.05	4.42	181.0	20.36	7.95	4.00	0.84	0.22
B_1	8–11	6.35	2.01	201.5	15.52	—	—	—	—
B_{21}	11–15	6.35	1.32	208.0	19.72	10.72	4.90	0.52	0.04
B_{22}	15–22	6.30	0.94	242.0	23.24	10.14	4.90	0.47	0.41
B_{23}	23–31	6.55	0.50	286.0	20.00	16.40	4.70	—	—
C_1	31+	6.45	0.43	315.0	20.76	9.44	4.90	0.46	0.60

The chemical analyses of the monolithic samples show unlimited amount of available fertilizing elements but apparently these are not being absorbed by the plants. The pH of the upper 8-inch soil layer is 6.05 which is within the most favorable range of hydrogen

ion concentration as suggested by Jacob and von Uexkull (1958). However, the yellowing may be attributed to some biological factors which hampered the roots of the coconut trees in absorbing the available major nutrients present in the profile.

Two-tree plots were used. There were five treatments arranged in a randomized complete block design and replicated four times. The treatments were (a) Control—no fertilizer treatment, (b) N—1 kg. of N per tree per year, (c) NP—1 kg. of N plus 1 kg. of P_2O_5 per tree per year, (d) NPK—1 kg. of N plus 1 kg. of P_2O_5 plus 1 kg. of K_2O per tree per year and (e) Witness—no treatment at all. At the beginning of the experiment the base of each tree was dug within a radius of 1 to 2.5 meters from the trunk, with the exception of the witness trees.

The fertilizers were applied twice a year, May and November, and in band about 1.5 meters away and around the trunk of the trees. Nitrogen was applied as ammonium sulfate (20 per cent N), phosphorus as superphosphate (20 per cent P_2O_5) and potassium as muriate of potash (60 per cent K_2O). The first fertilizer application was in April, 1955.

Leaf and soil samples were collected after two years (April, 1957), and analyzed in the Soils Laboratory.

Leaf samples were collected by getting arbitrarily from each tree one old, one middle, and one young unfolded frond. These were each subdivided into base, middle, and tip pinnae. Each subdivision consisted of seven pairs of pinnae taken after every two pinnae on each side of the frond. This makes a total of nine subsamples for each tree.

The leaf pinnae were wiped with wet cloth, rinsed with distilled water, dried in the oven at 75°C, ground in a Wiley mill, and then passed through a 20-mesh screen.

Sulfur and nitrogen were determined by the methods described in A.O.A.C. (1955).

Since the old and young fronds, including the tip and base pinnae, showed relatively higher coefficient of variation of their sulfur and nitrogen contents, only the average percentage amounts of sulfur and nitrogen of the middle pinnae of the middle fronds are given in table 5.

Composite soil samples were taken at random within the zone of fertilizer application. Each sample was obtained by making ten borings around each tree, 6 inches deep within a radius of 1 to 2.5 meters.

Phosphorus was determined by the modified Truog method (1930) and potassium, by the Wolf and Ichisaka technique (1947).

The soil pH of the 1:1 soil-water extract was determined with the use of a glass electrode.

RESULTS AND DISCUSSION

Effect of fertilizers on the growth and vigor of trees. The split application of 1 kg. of nitrogen per tree per year definitely improved the color and size of the leaves and the general vigor of the yellowing coconut trees. The effect of the fertilizer on the color of the leaves became evident three months after the first application. This indicated that the organic matter content of the soil is not liberating enough nitrogen to supply the needs of the coconut plants.

Effect of fertilizers on the number of harvested nuts. First year.—The treatments improved not only the general vigor and stand of the trees but also the number of harvested nuts in one year's time (table 2). The witness plot which was not dug and not fertilized

TABLE 2.—*Nuts harvested per plot of two trees during the first year (1955-56)*

TREATMENT	REPLICATION				MEAN
	I	II	III	IV	
Control–dug	2	22	15	17	14.0
N–dug	48	65	10	30	38.3
NP–dug	17	18	53	33	30.3
NPK–dug	22	29	19	21	22.8
Witness–not dug	5	1	17	3	6.5

showed an average yield of only 7 nlts per plot (two trees) whereas the control which was dug but not fertilized yielded 14 nuts per plot. This suggests that digging an area of 2.5 meters radius around the tree alone can improve the fruiting capacity of the yellowing trees, which further suggests that loosening the soils, which is recognized to favor aeration, miniralization of organic matter, and lowering of the concentration of toxic substances, has a positive relation to the improvement of yellowing coconuts. In this connection, it is in-

teresting to know from personal communication with farmers, that cultivation of old plantations near the experimental area doubled the yield.

The nitrogen plot with an average yield of 38 nuts per plot showed an increase of 24 nuts over the control; the nitrogen-phosphorus plot (yield:30 nuts) an increase of 16 nuts; and the nitrogen-phosphorus-potassium plot (yield: 25 nuts) had an increase of only 9 nuts. These increases over the control are not statistically significant; neither were the differences between treatments. However, these are strong indications that yellowing coconut trees can be restored to their normal appearance and stand with the use of fertilizers.

Second year.—It is apparent in table 3 that the trend of results during the first year is very different from that of the second year. In the first (table 2), the N plot showed a higher yield than either the NP or the NPK plots whereas in the second year, the N plot has a lower yield than either the NP or the NPK plots. This highly suggests that this coconut soil needs not only nitrogen but also phosphorus and potassium to give good yields in addition to plowing.

TABLE 3.—*Nuts harvested per plot of two trees during the second year (1956-57)*

TREATMENT	REPLICATION				MEAN
	I	II	III	IV	
Control–dug	12	27	57	63	40.3
N–dug	100	57	73	103	83.3
NP–dug	83	131	94	117	106.3
NPK–dug	158	122	91	124	123.8
Witness–not dug	10	9	36	16	17.8

C.V.—63.7%
HSD—5%—53.3
1%—69.0

The average yield per plot per year was 40 nuts for the control, 83 nuts for the nitrogen plot, 106 nuts for the nitrogen-phosphorus plot, and 124 nuts for the nitrogen-phosphorus-potassium plot. The increases over the control were 43, 66, and 84 nuts, respectively. Only the increases due to the application of nitrogen-phosphorus and nitrogen-phosphorus-potassium combinations are statistically significant, the former at 5 per cent level of significance and the latter at 1 per cent level. In this connection it may be mentioned that Sal-

gado (1953) reported an increase in yield of copra from 891 lbs. to 1282 lbs. with the application of 0.75 lb. K_2O per palm and an increase of 1437 lbs. with the application of 1.5 lbs. K_2O per palm.

The observation during the first year that digging 2.5 meters radius around the tree increased the yield was also true in the second. The increase by digging alone during the second year was 22 nuts per plot. This increase, however, is not statistically significant.

The increases in yield due to the individual elements during the second year, without taking fertilizer interaction into consideration, were N—43 nuts, P—23 nuts and K—18 nuts. From these figures, it seems that nitrogen has the greatest effect on the yellowing coconuts.

The average number of nuts harvested during the second year also bore close relationship with the level of soil fertility. The highest yield was obtained from the plot supposedly in the best state of fertility (NPK plot) and the lowest yield from the plot which had not experienced any soil management practice for the last two years (witness plot). These results concur with those of Bartolome (1954) in an experiment on old yellowing coconuts in Tiaong, Quezon.

The trend of improvement of the trees, as indicated by the number of harvested nuts, was conditioned by the relative completeness in fertilizer elements (table 4).

TABLE 4.—*Rate of increase in yield of coconuts*

TREATMENT	MEAN YEARLY YIELD IN NUMBER OF NUTS		
	1st year	2nd year	Rate of increase/yr.
Control	14	40.3	26.3
N–dug	38.3	83.3	45.0
NP–dug	30.3	106.3	76.0
NPK–dug	22.8	123.8	101.0
Not dug	6.5	17.8	11.3

In the plot that received no treatment at all, there was only a mean of 11 nuts increase whereas the plot that was dug only and not given fertilizer, the increase was 26 nuts. The plot which was dug and given nitrogen only showed a mean increase of 45 nuts; the plot which was dug and given nitrogen and phosphorus, 76 nuts; the plot which was dug and fertilized with nitrogen-phosphorus-po-

tassium combination, 101 nuts. These results show definitely the positive interactions of the different fertilizers.

Effect of fertilizers on the sulfur and nitrogen content of the leaves. On the assumption that the chemical composition of certain parts of the plant is associated with the yield, the sulfur and nitrogen content of the leaves were determined, both being essential in plant metabolism.

Table 5 shows that the application of 1 kilogram of N in the form of ammonium sulfate to the yellowing coconuts increased the sulfur content of the leaves significantly. The increase due to the N treatment was 0.20 per cent; NP, 0.15 per cent; NPK, 0.13 per cent. These increases were accompanied by an increase in the number of harvested nuts.

TABLE 5.—*Nuts harvested per two trees, sulfur and nitrogen content of the leaves of yellowing coconut after two years of fertilizer application*

TREATMENT	NUTS HARVESTED PER TWO TREES AFTER TWO YEARS	AVERAGE COMPOSITION OF THE LEAVES IN PER CENT [a]	
		S [b]	N [c]
Control–dug	54	0.84	1.06
N–dug	121	1.04	1.23
NP–dug	137	0.99	1.18
NPK–dug	147	0.97	1.21
Witness–not dug	24	0.92	1.02
	HSD—5%—0.09 1%—0.13		Insignificant

[a] Mean of eight determinations.
[b] Teodorico R. Escobar. The sulfur status of coconut leaves. Unpublished undergraduate thesis. 1958.
[c] Romulo L. Bayan. Nitrogen status of the leaves of fertilized and unfertilized coconut trees. Unpublished undergraduate thesis. 1958.

Table 5 also shows that the application of nitrogenous fertilizer in the soil consistently increased the nitrogen content of the leaves over the control. The increase was associated with the increase in yield of nuts.

The above trend of results shows that the analysis of the leaves of coconut provides a good picture of the state of nutrition of the plant and the state of fertility of the soil and should, therefore, be made to supplement the results of the soil analysis.

Effect of fertilizers on the pH, available phosphorus, and exchangeable potassium in the soil. Table 6 shows the effects of the fertilizers on the pH, available phosphorus, and exchangeable potassium in the soil. An application of 1 kg. of N per tree per year significantly increased the acidity of the soil in two years. A similar result was observed by Galvez, *et al.* (1955) on citrus soils fertilized with nitrogenous fertilizers.

TABLE 6.—*The pH, available phosphorus, and exchangeable potassium in the surface soil and nuts harvested per two trees after two years of fertilizer application.* [a]

TREATMENT	pH [b]	AVAILABLE PHOSPHORUS [b]	EXCHANGEABLE POTASSIUM [b]	NUTS HARVESTED PER TWO TREES AFTER TWO YEARS
		ppm	*ppm*	
Control–dug	5.77	179.06	191.3	54
N–dug	5.40	146.53	164.1	121
NP–dug	5.29	189.28	112.0	137
NPK–dug	5.42	163.26	225.6	147
Witness–not dug	5.74	165.36	205.0	24
HSD 5%	0.13	Insig.	46.45	
1%	0.16		56.63	

[a] Sofronio R. Gonzalez. The chemical analysis of fertilized and unfertilized yellowing coconut soil. Unpublished undergraduate thesis. 1958.
[b] Mean of eight determinations.

The decrease in the pH were 0.37 pH units for nitrogen treatment, 0.48 for NP, and 0.35 for NPK. These decreases are significant at 1 per cent level and can be attributed solely to the nitrogenous fertilizer. Galvez (1958) made mention of the fact that superphosphate and muriate of potash do not acidify soils.

The phosphorus content of the surface soil was decreased by 32.35 ppm in two years of the N treatment. This would indicate that the exhaustion of soil phosphorus by coconut plants would be precipitated with increased nut production resulting from the application of nitrogen (table 5). During the second year, the yield of the treatment is 43 nuts more than the control (table 3). Although the decrease is not significant, it indicates the magnitude by which phosphorus is changed in the soil for a certain increase in the yield. No decrease in the NP and NPK plots was noted. This might be due to the sufficient amount of phosphorus applied as fertilizer to replenish the amount absorbed by the trees for the production of the additional nuts.

Potassium showed results similar to those of phosphorus. It was decreased significantly in the NP treatment where the yield was markedly increased. This further indicates that good yield hastens the exhaustion of nutrients, and that replenishment of the absorbed nutrients could maintain the fertility of the soils. Its high amount in the NPK plot was due to the application of muriate of potash. The higher amount of potassium in the NPK plot than in the control indicates that the fertilizer applied was more than sufficient to meet the needs of the trees in increasing the yield.

It can be deduced, from the foregoing results, that beneficial effects are obtained not only from the application of nitrogen but also of phosphorus and potassium. All three should be applied in order to obtain maximum coconut yield. For better results, however, the area should first be plowed before applying the fertilizers. Furthermore, since the unlimited supply of available fertilizing elements in this soil are apparently not being absorbed by the coconut plants, this plantation needs loosening, eradication of amorseco and green manuring, or cover cropping.

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TOBACCO MARKETING PRACTICES OF FARMERS IN CABUGAO, ILOCOS SUR [1]

HERMINIA SOLLER RODRIGUEZ

The average size of the survey farms in Cabugao was 1.9 hectares; the tobacco production was 702 kilos per farm or 524 kilos per hectare.

Almost all of the operators' share of Virginia tobacco was sold. Seventy-three per cent of the "batek" was used for home consumption.

Grade C was the most common. Seventy-nine per cent of the sales was handled by local buyers. Most of the farmers gave cash on delivery as the reason for their choice of market outlets.

On the basis of individual transactions, FaCoMa, the chief source of price information, paid the highest price for each grade. However, on the average, alien buyers paid a higher price for all grades than did FaCoMa.

The greatest bulk of sale occurred in April. The price gradually decreased from ₱2.70 in February to ₱1.60 in June. In the latter month, 55 per cent of the sales was in grade E or Reject.

The tobacco industry is one of the oldest in the Philippines, especially in the northern provinces. As a result of the present price support for Virginia leaf tobacco (R.A. 1194), the production rose from about two million kilos in 1953-1954 to about eight million kilos in 1954-1955. The ACCFA alone paid the farmers ₱12,900,036 for Virginia leaf tobacco. The country's tobacco consumption for 1954 was estimated at 13 million kilos.[2]

Because of its increasing importance, an analytical study of tobacco marketing is propitious. Pricing difficulties may be attributed to defective organization or faulty operation of the marketing system. Better marketing must aim at increasing returns for the farmers and meeting the need of consumers on all levels.

Very little is known about the marketing aspects of tobacco produced in the tobacco regions of the Ilocos provinces. This re-

[1] Central Experiment Station Contribution No. 2028. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1959, No. 2687. Prepared in the Department of Agricultural Economics under the direction of Visiting Professor Horst von Oppenfeld and Mr. Teodoro B. Baguilat.

[2] F. M. Sacay, *The Cooperative Farmer* (1955).

search study would promote understanding of the various marketing operations and help in finding out how the existing system might be improved and be made more efficient.

The present investigation was undertaken to determine (1) the marketing practices and services involved in the movement of tobacco from producer to first buyer, (2) the various marketing outlets used by farmers in disposing of their tobacco, (3) prices received, and (4) costs of marketing services.

METHOD

One hundred-forty-five farmers were personally interviewed in fourteen barrios of Cabugao, Ilocos Sur, from July to August, 1957. Information for the crop year 1956-1957 was obtained and recorded on schedules prepared in the Department of Agricultural Economics, College of Agriculture, University of the Philippines. The tabulation, analysis, and interpretation of the data were done in the Department under the supervision and direction of the advisory staff.

The barrios were selected on the basis of productivity of Virginia leaf tobacco and geographical location. The number of samples selected was proportionate to the total number of farmers in each barrio. To obtain more adequately the information sought, only farmers who marketed Virginia leaf tobacco were included in the study. This resulted in farms that were larger in size, had higher production, and consequently, greater value of sales than those who did not.

Cabugao has eighty-one barrios and a total population of 14,823 in 1948.[3] Out of a total land area of 6,570 hectares, 3,355 hectares constitute farm area.[4] Rice and tobacco are the major crops, while corn, sugar cane, fruits, and vegetables are the minor crops.

Cabugao is accessible by first-class road. The barrios, however, can be reached only by feeder roads. The most common means of transportation used by the farmers in moving their products to the market are carts and carabao-drawn sleds.

THE FARM AND THE FARMERS

Tobacco farming in Cabugao, Ilocos Sur, is done only during the dry season. The average size of the farm was 1.9 hectares of

[3] Census of the Philippines, 1948, p. 101.
[4] Summary Report of 1948 Census of Agriculture.

which 1.4 was planted to tobacco. The total tobacco production averaged 702 kilos per farm or 524 kilos per hectare.

Tenure status. The incidence of tenancy in the surveyed area was low. Less than one fifth of the farmers were tenants (table 1). A recent study disinguished Ilocos, Cagayan, and Mindanao has having much less of tenancy than any other regions in the country.[5]

TABLE 1.—*Tenure status of 145 farmers surveyed in Cabugao, Ilocos Sur, 1956-1957*

TENURE STATUS	DISTRIBUTION OF FARMS	
	number	*per cent*
Owner	70	48
Part-owner	49	34
Tenant	26	18
Total	145	100

Disposal of operators' share. Almost all of the operators' share of Virginia leaves were sold (table 2).

TABLE 2.—*Disposal of operators' share*

DISPOSITION	VIRGINIA		BATEK	
	kilos	*per cent*	*manos* [a]	*per cent*
Sold	625.5	100	1.4	11
Home use	0.1	[b]	9.5	73
Given away	0.3	[b]	[c]	[b]
Stored	—	—	2.0	15
Bartered	0.7	[b]	0.1	1
Total	626.6	100	13.0	100

[a] One "mano" is equivalent to 100 leaves of varying length and width.
[b] Less than 0.05 per cent.
[c] Less than 0.05 mano.

Virginia tobacco serves primarily as a filler in cigarette manufacture and is not suited for cigar purposes. For farmers' home smoking, most or all used cigars rolled from "batek", the native variety of tobacco. Besides, they considered that it would be better to sell the Virginia leaves rather than use them since these leaves gave them more returns than the native or "batek" variety. A negligible per-

[5] Oppenfeld *et al.*, *Central Experiment Station Bulletin* 1 (1957).

centage was used at home for either cigars or cigarettes, given away, or bartered with native-made stoves and native pots for kitchen utility.

The produce of "batek" was mainly for home use as cigars. This represented about 73 per cent of the total operators' share. About 15 per cent was stored most possibly for future home use.

PRE-SALE PRACTICES

Virginia tobacco was seeded in the latter part of October up to early November. After three months, the tobacco leaves were ready for the first harvest, usually in February, the month of sales.

Flue-cured tobacco leaves were stored and piled up in order to have fine and smooth leaves which were heavier than the newly cured ones. This storing of leaves lasted for about a month because further storing would cause discoloration and, hence, down-grading of leaves. After this the cured leaves were ready for selling.

Relation of pre-sale practices and number of workers. Workers needed in poling to prevent deterioration of tabacco leaves are biggest in number. Half of these workers were family members; over one-third, hired laborers; and the rest, operators. Harvesters, the bulk of which were again family members, ranked next. Many workers were also needed in this operation because all mature tobacco leaves at any given time must be picked promptly and singly from the stalk. Over-mature leaves would result in lower grades.

The operator busied himself in both drying and transportation. Storing was undertaken almost entirely by the family members.

Distribution of man-days. The family members did most of the chores in storing and grading (table 3). They performed over half of the harvesting and poling work. On the other hand, operators used three-fourths of their time in drying. The hired men accomplished a third of the poling. This is their largest share among all practices. Like the operator, they spent little time in grading and storing.

Distribution of man-days among pre-sale practices. A greater part of the operators' working days was devoted to drying (table 4). He spent the shortest time in storing and grading. The members of his family worked 41 per cent of the time in grading and 32 per cent

in poling. They spent the least time in drying and storing. The hired workers were generally employed for poling and harvesting work.

TABLE 3.—*Distribution of man-days among types of workers for each pre-sale practice*

PRACTICES	TYPES OF WORKERS			TOTAL
	Operators	Family members	Hired workers	
	per cent			
Harvesting	17	58	25	100
Poling	12	55	33	100
Drying	76	12	12	100
Grading	9	82	9	100
Storing	5	92	3	100
All practices	24	56	20	100

TABLE 4.—*Average number of days spent for each pre-sale practice by types of workers*

PRACTICES	TYPES OF WORKERS			ALL WORKERS
	Operators	Family members	Hired workers	
	average number of days			
Harvesting	12	14	12	13
Poling	15	20	17	18
Drying	66	47	83	64
Grading	18	32	30	30
Storing	3	2	12	6

Poling took up almost a third of all workers' time while grading consumed 28 per cent. Very little time was spent in storing.

Average number of days by types of workers. Although poling required the greatest total number of man-days, the average of 18 days for all workers was very low as compared to the average of 64 days required in drying. Workers hired for the drying operation, although fewer, worked longer, thus resulting in the highest average of days. Grading required an average of 30 days for all workers and ranked second in all operations.

Labor value. Workers charged the highest for drying which was ₱2.60 per day (table 5). Hired laborers exceeded in income other workers.

TABLE 5.—*Value of time for pre-sale practices by type of worker*

PRACTICES	TYPES OF WORKERS			ALL WORKERS
	Operators	Family members	Hired workers	
		pesos per day		
Harvesting	2.00	1.97	2.00	1.98
Poling	2.00	1.98	1.98	1.98
Drying	2.47	2.43	3.59	2.60
Grading	2.02	1.99	1.97	1.99
Storing	1.81	1.96	2.00	1.96
All practices	2.31	2.00	2.17	2.11

This is due to lack of experienced and skilled laborers, coupled with the seemingly non-conducive conditions surrounding the work. Only the operator who rated ₱2.31 daily exceeded the hired laborers. Later valuations for the other practices were considerably lower and varied only slightly from one another.

SALES OF VIRGINIA TOBACCO

Number of sales. The incidence of sales ranged from one to thirteen times per farmer. Generally, four to five sales were made before farmers finally disposed of their crop of Virginia tobacco. Only a few farmers represented by part-owners made from nine to thirteen sales.

Tobacco grades. Virginia tobacco is sold according to standard grades (appendix "A"). The sales of grades B, C, and D represented two-thirds of the total marketings. The relative importance of each grade is generally the same regardless of tenure status. However, in superior grades, like A and B, owners excelled the part-owners and tenants in their volume of sales.

It is possible that the classification as gathered from farm sales is a more reliable indication of the quality of the raw materials than that obtained from other transactions. It can be said that 70 per cent of sales represent the poorer grades, e.g., grades C and lower.

Grades by months. Grade C was the most important single grade, representing 31 per cent of all sales throughout the year. Except at the beginning and end of the season, it was one-third of

the total sales during the height of the marketing season which was from March to May.

Month of sale. The tobacco marketing season begins in February and ends in July (table 6). At the beginning, in February, only a few farmers made sales, but it rapidly gained impetus until it reached the greatest bulk in April and tapers down to the end of the season. By this time, the fields are again prepared for palay cropping.

TABLE 6.—*Number* [a] *and amount* [b] *of sale by months, 145 farmers, Cabugao, Ilocos Sur, 1956-1957*

MONTH	NUMBER OF SALE	AMOUNT SOLD
	per cent	
February	1	1
March	18	18
April	40	42
May	25	26
June	16	13
July	[c]	[c]
Total	100	100

[a] 90,698 kilos.
[b] Less than 0.5 per cent.
[c] 694 sales.

Months and types of buyers. Buying was increased normally from February until its peak in April and was completed in July. While this is the general pattern, some variations may be observed among the various types of buyers.

BUYERS

Types of buyers. The most common marketing outlets were the local buyers (table 7). They represented amost four-fifths by number of sales, or two-thirds in terms of total volume. Some of these local buyers may actually be the agents of alien wholesale distributors. On the surface, then, the alien buyers appear as a poor second. They are direct purchasers in only 11 per cent of the number of sales. But the alien participation must be viewed more in terms of the volume handled which was 23 per cent. The FaCoMa and landlords were comparatively unimportant buyers in the area.

TABLE 7.—*Types of buyers chosen by farmers and size of sales*

TYPES OF BUYER	NUMBER OF SALES	QUANTITY BOUGHT	AVERAGE KILOS PER SALE
	per cent		
Local buyers	79	68	112
Aliens	11	23	265
FaCoMa	6	5	114
Landlords	4	4	150
Others [a]	[b]	[b]	81
Total	100	100	—

[a] PTA and buyers from other places.
[b] Less than one per cent.

Size of sale. Although appropriating most of the sales, local buyers deal in small amount each time (table 7). An alien purchase at any single instance tended to average more than twice that of the local buyer. The landlords also bought in larger amounts. The aliens and landlords can do this considering that they have larger capital than the local buyers.

Size of sales by types of buyer. Purchases amounting to less than 300 kilos were made by the FaCoMa, local buyers, and others (table 8).

TABLE 8.—*Frequency distribution by volume of sales for each type of buyer*

VOLUME OF SALES IN KILOS	TYPES OF BUYER					ALL BUYERS
	Local buyer	Aliens	FaCoMa	Land-lord	Others	
Number of sales	547	79	39	25	4	694
	per cent of number of sales					
Below 300	27	3	25	20	50	25
300–599	30	20	54	48	—	30
600–1799	39	55	13	32	50	39
Above 1799	4	22	8	—	—	6
Total	100	100	100	100	100	100

Seventy-nine per cent of FaCoMa's number of purchases was below 600 kilos. Farmers with volume of sales above 600 kilos sold more frequently to aliens. Aliens dealt more with big producers and vice versa as indicated in table 9.

TABLE 9.—*Percentage distribution of quantity sold among types of buyer for each volume of sale*

VOLUME OF SALES IN KILOS	TOTAL KILOS	TYPES OF BUYERS					TOTAL
		Local buyer	Alien	FaCoMa	Land-lord	Others	
		per cent of total kilos					
Below 300	9,084	85	2	8	4	1	100
300–599	20,059	73	10	10	7	–	100
600–1799	46,693	69	23	3	4	1	100
Above 1799	14,862	43	53	4	–	–	100
All volumes	90,698	68	23	5	4	[a]	100

[a] Less than 0.5 per cent.

Types of buyers and grades bought. The local buyers were the most important single group of buyers, amassing a little more than two-thirds of the total volume of sales of all grade (table 9). The aliens bought a little less than one-fourth. Since some of the local buyers were actually agents of alien buyers, this amount is underestimated. It will be noted that the FaCoMa bought an insignificant amount.

TABLE 10.—*Percentage distribution of sales volume among types of buyer for each grade*

GRADE	TOTAL KILOS	LOCAL BUYER	ALIENS	FACOMA	LAND-LORD	OTHERS	TOTAL
				per cent			
A	3,965	41	49	7	2	1	100
AB	2,223	62	30	4	1	3	100
B	18,054	72	18	7	3	–	100
BC	2,764	48	39	7	2	4	100
C	28,126	65	24	5	6	[a]	100
CD	1,606	64	17	8	11	–	100
D	14,229	68	23	5	4	[a]	100
DE	1,322	92	3	1	4	–	100
E	7,577	72	30	5	3	[a]	100
Reject	7,964	84	11	2	3	–	100
Assorted	2,863	91	9	–	–	–	100
All grades	90,698	68	23	5	4	[a]	100

[a] Less than 0.5 per cent.

For any given grade except grade A, the local buyers dominated the volume of marketing. What should be observed also is the

extent of their position for each of the grades. The local buyers figured more prominently among the poorer grades than among the better ones. For instance, for grade AB, local buyers bought 62 per cent. Their relative position for grades R and Assorted was even higher, being 84 and 91 per cent, respectively.

In contrast, the aliens bought more of grade A. Their share of grade R and Assorted is 11 and 9 per cent, respectively.

Reasons for choosing buyers. Farmers had varied reasons in choosing their buyers. A majority sold for immediate cash payment upon delivery.

Another important consideration was the convenience offered by the buyers. Transportation labor and cost were usually shouldered by the buyers. Farmers preferred those buyers who directly buy from them.

Sources of price information. Although farmers in the survey area did not sell frequently to FaCoMa, they looked upon this agency as their primary source of price information. Neighbors, being the immediate contact, constituted another source and only one-fifth of the farmers looked elsewhere. Other farmers depended on their relatives and friends.

Methods of payment. Most of the farmers sold their tobacco on the basis of cash on delivery. Ninety-five per cent of the total quantity was sold by this method. Only five per cent was sold on credit purchase, the same amount offered by the FaCoMa.

PRICES

Prices for Virginia tobacco are legally governed by grades such as A, B, and others. For leaves believed to be in between two specified grades, the price is intermediate between the higher and lower grades.

Prices offered by different types of buyers. The alien buyers paid a higher price for all grades. For most of the grades, the FaCoMa paid slightly higher prices than did the rest of the Virginia tobacco buyers (table 11).

This may be due to the fact that the FaCoMa, being an agency supervised by the ACCFA, had to buy different grades at their prescribed prices. In other words, the price must always conform with the grade once the tobacco delivered had been classified. On the

other hand, the other private and individual buyers might have attemped to bargain for lower prices.

TABLE 11.—*Average price per kg. for each grade by type of buyer, 145 farmers, Cabugao, Ilocos Sur, 1956-1957*

GRADE	TYPES OF BUYER					ALL BUYERS
	Local buyer	Alien	FaCoMa	Landlord	Others	
	pesos per kilo					
A	3.51	3.59	3.60	3.51	3.78	3.54
AB	3.24	3.24	3.30	3.25	3.32	3.25
B	2.94	2.98	3.00	2.93	—	2.95
BC	2.67	2.71	2.75	2.75	2.75	2.69
C	2.44	2.47	2.50	2.43	2.50	2.45
CD	2.23	2.26	2.25	2.20	—	2.23
D	1.94	1.98	2.00	1.93	2.00	1.95
DE	1.63	1.66	1.75	1.50	—	1.64
E	1.36	1.46	1.50	1.43	1.50	1.39
Reject	.68	.79	.86	.65	—	.70
Assorted	1.98	2.20	—	—	—	2.00
All grades	2.23	2.50	2.40	2.33	2.63	2.29

Prices by months. In general, it may be said that prices failed to exhibit any marked seasonal pattern (table 12). For any given grade, the monthly differentials amounted to only a few centavos.

TABLE 12.—*Monthly prices for each grade*

GRADE	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	ALL MONTHS
				pesos			
A	3.60	3.52	3.54	3.57	3.57	—	3.54
AB	3.25	3.24	3.24	3.25	3.25	—	3.25
B	2.93	2.93	2.95	2.98	2.98	—	2.95
BC	2.75	2.70	2.68	2.71	2.72	—	2.69
C	2.43	2.43	2.44	2.46	2.48	—	2.45
CD	2.30	2.24	2.23	2.25	2.21	—	2.23
D	2.00	1.94	1.95	1.96	1.97	—	1.95
DE	1.75	1.61	1.61	1.66	1.62	—	1.64
E	1.50	1.29	1.35	1.43	1.40	—	1.39
Reject	—	.65	.65	.68	.71	1.00	.70
Assorted	—	2.40	2.12	1.85	1.10	—	2.00
All grades	2.70	2.59	2.49	2.12	1.60	1.00	2.29

The absence of any seasonality in prices is due to the purchase program of the government for Virginia tobacco.

The general average prices by months revealed a decreasing trend. This is because the lower grades increased proportionately to the total sales from April through July. The early months were heavily weighted by the sales of the higher-priced grades (table 13). As the harvesting and marketing season progresses, more and more of the lower quality leaves enter the market. Thus, at the end of the season the price is heavily weighed down by the lower grades.

TABLE 13.—*Percentage distribution of number of sale among grades by months*

GRADE	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	ALL MONTHS
Number of sale	23	311	759	456	250	1	1800
				per cent			
A	13	10	12	5	2	—	9
AB	9	8	5	2	1	—	4
B	31	24	21	16	8	—	18
BC	4	6	4	2	1	—	3
C	22	26	24	22	15	—	23
CD	4	4	2	1	2	—	2
D	4	15	18	20	14	—	17
DE	9	1	1	2	2	—	2
Reject	—	1	2	11	39	100	9
Assorted	—	1	2	3	[a]	—	2
Total	100	100	100	100	100	100	100

[a] Less than 0.5 per cent.

APPENDIX "A"

Republic Act 1194—enacted August, 1954, the law which evolved a price support program for Virginia leaf tobacco. Required ACCFA to buy all Virginia leaf tobacco produced.

Flue-cured Virginia

LEAF CLASS	STANDARD COLOR SPECIFICATION	PRICE/KILO
A	Bright yellow leaf	₱3.60
B	Drill " "	3.00
C	Spotted " "	2.50
D	Greenish and brownish yellow leaf	2.00
E	Dark to other kinds	1.50
	Sundried	
SDA	Light brown	1.50
SDB	Brown leaf	1.00
SDC	Dark brown leaf and other kinds	.80

NOTE: CYTOLOGY OF PHILIPPINES PLANTS V. *PSOPHOCARPUS TETRAGONOLOBUS* (LINN.) DC.

The cultivation in the Philippines of *Psophocarpus tetragonolobus* is very common. It is primarily raised for its fruits but the young shoots, flowers, and roots are equally edible.[1] This species is believed to have been introduced into the Philippines from India and Malaya. Merill [2] gives the botanical description as follows:

> A glabrous, twinning annual vine reaching a length of 6 meters or more. Leaves 3-foliolate, leaflets ovate, entire, acuminate 8 to 14 cm. long, base deltoid. Racemes few—flowered up to 15 cm. in length. Flowers light blue, 3 to 3.5 cm. long. Pod square. 10 to 20 cm. long, about 2 cm. thick, 4-winged, the wings about 5 mm wide, crisped.

The young flower buds were collected from several plants and were fixed in Farmer's fluid. Cytological studies of the pollen mother cells was done using the standard acetocarmine smear technique.

OBSERVATIONS

Psophocarpus tetragonolobus was observed to have a gametic chromosome number of 13 (fig. 1). Two chromosomes were observed to be attached to the nucleolus. A detailed study of the chromosome morphology was not possible on account of the close clumping of the chromosomes at Pachynema (fig. 2). Chromosome knobs were evident but their locations could not be ascertained. The centromeres of the individual chromosomes were not visible under the scope used in this study.

—*Dolores A. Ramirez*

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[1] W. H. Brown, "Useful plants of the Philippines *2*," Bureau of Printing, Manila, 1954, pp. 160-162.

[2] E. D. Merrill, "A flora of Manila," 1912, p. 24.

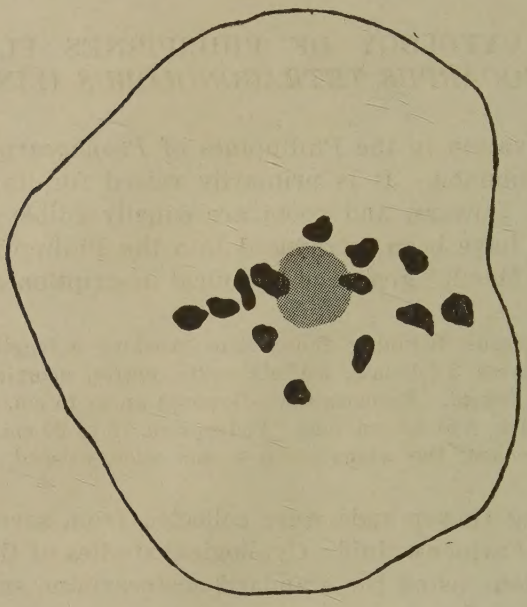

Fig. 1. *Psophocarpus tetragonolobus* pollen mother cell at diakinesis

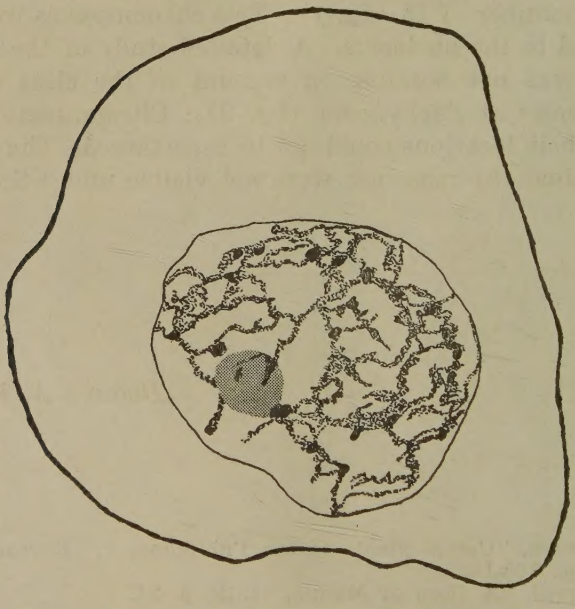

Fig. 2. PMC of *Psophocarpus tetragonolobus* at pachynema

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